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This paper presents the results of a multivariate regression analysis of factors contributing to the bid-ask spread in government of Canada bonds. Unlike previous research, which employed fewer data, this study found that a bond's coupon rate and yield to maturity were inappropriate explanatory variables. The signs of their coefficients ranged from significant positive to significant negative. For various time periods, 43%–94% of the variance of bid-ask spreads was explained by a model which employed only the quantity of the issue outstanding and the bond's duration as independent variables. The signs of the coefficients of these variables were, respectively, consistently significant negative and significant positive, as expected.

I

In "The Determinants of the Difference between Bid and Ask Prices on Government Bonds," Tanner and Kochin (1971) examined the question of transactions costs in the secondary market for government of Canada bonds. Following as it did Demsetz's seminal article, theirs was a relatively early piece of research into an issue which has received an increasing amount of attention.[1]

One of the purposes, either explicit or implicit, of these studies is to determine the extent to which transactions costs appear to be justified. From an operational perspective, we are concerned with whether the transaction "cost is appropriately economized" (Demsetz 1968). In terms of efficient resource allocation, the existence of transactions costs is also important. Demsetz noted that, if transactions costs were zero, the inefficient allocation of resources associated with monopoly and monopsony could be eliminated by the costless negotiation of side payments. Analogously, if external efficiency[2]

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1. A partial list of relevant articles includes Demsetz (1968), Tinic (1972), Tinic and West (1972, 1974), and Benston and Hagerman (1974).
2. For a more complete discussion of the distinction between external and internal efficiency, and their relationships to allocational efficiency, refer to West (1975).

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—the establishment of prices which fully reflect all available information—obtained in the capital markets and transactions costs were zero, then allocational efficiency would exist in the capital markets. In the presence of transactions costs as part of the information set, both internal efficiency—the provision of minimum cost operating services—and external efficiency are prerequisites for allocational efficiency. Therefore, we must be concerned with the extent to which the price of transactions is justified by their costs.

The purpose of this paper is to present a respecification of the determinants of bid and ask spreads on government bonds. We believe that the model presented here (albeit very similar) is theoretically preferable to, and empirically stronger than, that discussed and tested by Tanner and Kochin. We will address the former point in the next section and the latter in our third section. A summary will close the analysis.

II

The dealer who makes a market in bonds is acting much like a retailer. He acquires bonds from one source and sells them to another. The difference between his purchase price and his sale price is analogous to the retailer's markup. In addition to this source of revenue, the dealer also earns a rate of return on his inventory portfolio. To establish the size of his markup, the dealer must plan on earning revenues sufficient to compensate for all of his factor inputs, including a return to capital.

Although we do not have data on the costs of operations, we can hypothesize two relationships which should influence the size of the markup. First, the cost of transactions for an issue may vary inversely with its volume of transactions. This hypothesis originates with the contention that the liquidity which dealers will be required to inject into the market will vary inversely with the time rate of transactions.[3] This, in turn, lowers inventory costs. Since volume data are not available, we will use, as did Tanner and Kochin, quantity outstanding as a proxy variable.

The second influence on the cost of transaction is the risk of the bond. While it is true that the dealer's inventory earns a market-determined rate of return, this may not be a sufficient return to capital. At the very least, dealers may be exposed to levels of risk which differ from those of other investors. To the extent that bond investors can match the term of the bond to their planning horizons, they may view the bond as having low risk. The dealer, on the other hand, is likely to

3. The more active a bond is, the more quickly will investors create demand or supply pressure to adjust a price which is out of equilibrium. This will reduce the waiting time for a potential trader who wishes to sell, for example, a temporarily undervalued asset, and will increase the propensity to wait. Such increased waiting will enhance the probability of offsetting, as opposed to positioning, trades by the dealer. In turn, this reduces the risk capital requirements and risk exposure and leads to narrower spreads.

be concerned with the short-term fluctuations in the market value of his inventory portfolio.

As a measure of the riskiness of a bond issue we propose Macaulay's duration. (For a review of this concept, refer to Weil [1973].) The rationale for this choice is based on its relationship to the risk of capital, as measured by the percentage change in value induced by a change in the market discount rate. With discrete discounting the relationship is:[4]

$$\frac{dV/V}{di} = \frac{-D}{(1 + i)}, \tag{1}$$

where V is bond value, i is the market discount rate, and D is duration, the time-weighted average of an asset's present value.[5]

Since the duration of a dealer's portfolio is a weighted average of the duration of the individual assets, this measure is especially applicable. Unless dealers implement an immunization strategy which offsets the effects of individual transactions on the portfolio's duration (and we have no reason to believe that this might be the case), then a bond's duration accurately measures its contribution to the risk of portfolio value changes caused by unexpected changes in the interest rate.

Tanner and Kochin employed arguments similar to these to justify using term to maturity and coupon rate as the relevant empirical measures of risk. Duration is compatible with, but preferable to, these two measures.

The other independent variable used by Tanner and Kochin was the yield to maturity of the bond. Neither of the arguments which they offered as support for the theoretical significance of this variable was compelling. They argued that spread and yield should vary inversely because higher yields indicated the existence of higher risk, and larger spreads necessitated larger yields if the bond might be sold before its maturity. The latter point would appear to confuse cause and effect. We take issue with the former because:[6]

4. Convenient derivations of this equation can be found in Fisher (1966), and Hopewell and Kaufman (1973).

5. Where P_t represents the present value of the cash flow in time period t, we have

$$D = \sum_{t=1}^{n} tP_t / \sum_{t=1}^{n} P_t.$$

6. We use a constant discount rate in calculating duration. For a discussion of the problems with this technique, see Carr, Halpern, and McCallum (1974).

$$\frac{dV/V}{di} = -\frac{D}{(1 + i)},$$

$$\frac{d(dV/V)}{di^2} = \frac{1}{(1 + i)^2}\left[D - (D^2/V^2) - \left(\sum_{t=1}^{n} P_t t^2/V \right)\right].$$

$$\frac{d(dV/V)}{di^2} < 0. \tag{2}$$

As yield increases the risk of capital decreases. Therefore, our study will include yield only as an implicit factor subsumed in our measure of risk, duration.

III

In this section we will test the explanatory power of models which are based upon the foregoing theoretic arguments. As well, we will compare these results with those generated on the same data by the Tanner and Kochin models. We selected the same basic data base as that used by Tanner and Kochin. Instead of one cross-sectional sample of government of Canada bonds, however, we gathered the data on seven cross sections, each 1 year apart. Each sample was taken from the *Financial Post* for the end of October, with the first year being 1969 (approximately the same time as Tanner and Kochin's single sample); the seventh sample was for the end of October 1975.

Shown below are four alternative specifications of models which explain the spread or transactions costs in the bond market. Other specifications, similar to these, are also compatible with the theoretic arguments which were developed earlier. These, then, are representative of a set of possible models:

$$S = a + b_1 Q + b_2 D, \tag{3}$$

$$S = a + b_1 \ln Q + b_2 D + b_3 V, \tag{4}$$

$$S/V = a + b_1 Q + b_2 D, \tag{5}$$

$$\ln S = a + b_1 \ln Q + b_2 \ln D. \tag{6}$$

Each of these models, and others not detailed, represents slightly different assumptions about the relationship between transactions costs and the other variables. Our final choice among the alternatives was dictated primarily by econometric considerations. The variables Q and D were not significantly correlated. Their correlation coefficients varied from .28 to $-.30$ for the seven periods. On the other hand, V and D exhibited significant correlation coefficients ranging from .88 to .67. Consequently, interpretation of estimates based upon equation (4) would be complicated by multicolinearity, while estimation of equation (5) could provide biased estimates of b_2. Of the remaining models, equation (3) provides the greatest explanatory power, and we will report the results of our estimates of it. Our omission of V, market price, from this model of bond transactions costs is not as serious as it

Since the negative term in parentheses is larger than D, the sign of the expression is negative. Therefore, as the yield to maturity increases, ceteris paribus, the interest rate risk declines.

might be for a common stock model, because the bond prices are more homogeneous.

For comparative purposes we also estimated the two equations which Tanner and Kochin proposed and tested on one cross section:

$$S = a + b_1Q + b_2T + b_3C + b_4Y, \tag{7}$$

$$\ln S = a + b_1 \ln Q + b_2 \ln T + b_3 \ln C + b_4 \ln Y. \tag{8}$$

The T represents term to maturity in years, C is the coupon rate, and Y is the yield to maturity.

The estimation results for equation (3) (our best model) and equation (7) (Tanner and Kochin's better model) are summarized in tables 1 and 2.

The estimates indicate that spread was significantly (95%) positively related to duration in all seven samples. The dependent variable was significantly (95%) negatively related to the quantity of issue outstanding in six of seven samples. The sign of the seventh coefficient was negative but not significant. The average R^2 for these seven samples was .67. The low values of the D-W statistic suggest the presence of autocorrelation of the type discussed by Tanner and Kochin (1971).[7]

We find the estimates of equation (7) to be inferior to those reported for our equation (3). While all seven of the term to maturity coefficients are significant, one carries the wrong sign, negative. The quantity of issue outstanding has seven negative coefficients, as expected, and five of these are significant. The bonds' coupon rates gave rise to four

TABLE 1 **Estimation Results for $S = a + b_1Q + b_2D$**

	a	b_1	b_2	R^2	F	D-W	No. of Observations
1969	.239	−.0305 (−2.38)	.0886 (7.05)	.55	24.97	1.48	41
1970	−.006	−.0399 (−2.70)	.1289 (9.36)	.73	44.60	1.37	34
1971	.194	−.0114 (−1.60)	.0467 (4.95)	.43	13.57	1.30	35
1972	.109	−.0301 (−2.93)	.0936 (10.72)	.74	58.76	1.92	41
1973	.074	−.0330 (−4.01)	.1058 (14.48)	.86	108.37	1.47	36
1974	.116	−.0545 (−2.94)	.2092 (18.37)	.94	209.89	.67	29
1975	.010	−.0415 (−2.19)	.1685 (9.00)	.71	44.17	2.04	37

NOTE.—Q is measured in millions of dollars.

7. For our study, the influential independent variable is duration, not term to maturity.

TABLE 2 Estimation Results for $S = a + b_1Q + b_2T + b_3C + b_4Y$

	a	b_1	b_2	b_3	b_4	R_2	F	D-W
1969	−3.6410	−.03796	.03391	−.14371	.63911	.60	15.82	.89
		(−3.00)	(5.27)	(−4.24)	(2.67)			
1970	1.1225	−.04302	.05861	−.12232	−.02384	.76	27.19	1.50
		(−2.72)	(5.13)	(−2.57)	(−2.04)			
1971	−1.8316	−.00868	−.03186	.02151	.44420	.69	19.91	2.16
		(−1.59)	(−3.07)	(.89)	(5.98)			
1972	−.2989	−.02241	.04568	−.01003	.05130	.73	28.56	2.12
		(−2.12)	(6.07)	(−.039)	(1.09)			
1973	1.36091	−.02340	.07537	.00758	−.19990	.95	175.24	1.54
		(−4.86)	(22.82)	(.58)	(−5.81)			
1974	−1.5080	−.03950	.09480	−.03309	.25362	.90	62.81	.47
		(−1.61)	(9.99)	(−1.11)	(2.85)			
1975	2.1939	−.04160	.08548	−.14189	−.12910	.69	21.17	1.51
		(−2.09)	(5.20)	(−3.76)	(−.81)			

NOTE.—Q is measured in millions of dollars.

insignificant coefficients, two positive and two negative, while three of the coefficients were negative, as expected, and significant. The coefficients for the yield term were evenly divided: negative and significant, 2; negative and insignificant, 1; positive and insignificant, 1; and positive and significant, 3. The average coefficient of determination for these seven samples was .76. These estimates also gave evidence, through low D-W statistics, of positive autocorrelation.

Summary

In this study we have proposed an alternative measure of the risk of capital which is borne by a dealer in the secondary bond market. For bonds of homogeneous default risk (government bonds) we have tested various specific formulations of the relationship between percentage transactions costs and the measure of risk, duration. Included in these models is a proxy (size of issue) for the time rate of transactions. A linear relationship between the transactions costs and the two independent variables yields significant regression coefficients with the expected signs. These results are consistent for samples drawn from seven different time periods. Since the alternative model did not possess these characteristics or any other superior attributes, we conclude that the new model is preferred on both theoretic and empirical bases.[8]

With respect to other studies of transactions costs in the capital market, we can draw two relevant conclusions. The significance of the size of issue outstanding in a market with many dealers is consistent with the evidence (on this point, see Hamilton [1973]) that higher industry volume decreases costs for all participants, as opposed to the hypothesis that increasing volume leads to economies of scale at the dealer level and creates a natural monopoly. Earlier studies have disagreed on the empirical importance of risk as a determination of transactions costs.[9] Our findings support the position that risk, properly measured, is an important determinant of transactions costs.

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8. Studies of several other markets which are reported in Grant and Whaley (1976) support this contention.

9. Tinic and West (1972) reported no influence when using a volatility measure of risk. Benston and Hagerman (1974), on the other hand, found that transactions costs varied directly with unsystematic risk, but did not vary with systematic risk.

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